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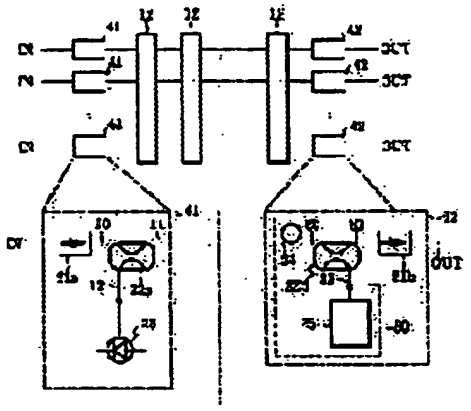
(54) OPTICAL CROSS CONNECT DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To reduce number of optical devices and an optical loss and to attain economy and high performance by modulating a stimulated light source for an optical signal amplifier with an identification signal, demodulating and detecting the signal without the use of a light source exclusive for monitor light and an optical multiplexer demultiplexer.
SOLUTION: An optical signal from an input terminal IN is given to an optical switch section 12 via an optical isolator 21a and an optical demultiplexer 22a of a monitor arrangement section 41, amplified by an optical amplifier medium 24 of a monitor arrangement section 42, and outputted to an output terminal OUT via an optical multiplexer section 22b and an optical isolator 21b. On the other hand, a stimulated light for an optical amplifier medium 24 from a light source 25 is modulated by a modulation pattern different from each channel. Furthermore, the light is detected and demodulated by a receiver 23 via the optical amplifier medium 24, the optical switch section 12, and the optical demultiplexer 22a of the monitor arrangement section 41 from the optical multiplexer 22b to specify from which light source the light is received. Thus, the connection state of the



optical switch section is monitored without use of exclusive monitor light source and optical demultiplexer. Moreover, number of optical devices is reduced, the optical loss and the branch insertion loss are reduced.

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CLAIMS

[Claim(s)]
[Claim 1] Two or more input edges into which a lightwave signal is inputted, and the optical switch section which makes change selection of the method way of an output of the lightwave signal inputted from this input edge, and is outputted to either of two or more outgoing ends, In the optical cross connect equipment which is equipped with a light amplifier and contains the excitation light light source and an optical amplification medium in this light amplifier said light amplifier It has for said two or more outgoing ends of every, respectively. Said excitation light light source Become irregular with a respectively identifiable signal for two or more of these outgoing ends of every, and it has a means to make said method way of an output go back in said direction of an input edge, and to make this excitation light transmit to it. Said optical amplification medium is optical cross connect equipment characterized by having been prepared between said excitation light light sources and said optical switch sections, and equipping said two or more input edges with the means which carries out the reception recovery of this excitation light.
[Claim 2] Two or more input edges into which a lightwave signal is inputted, and the optical switch section which makes change selection of the method way of an output of the lightwave signal inputted from this input edge, and is outputted to either of two or more outgoing ends, In the optical cross connect equipment which is equipped with a light amplifier and contains the excitation light light source and an optical amplification medium in this light amplifier said light amplifier It has for said two or more input edges of every, respectively. Said excitation light light source Become irregular with a respectively identifiable signal for two or more of these input edges of every, and it has a means to make said method way of an output transmit this excitation light in said direction of an outgoing end. Said optical amplification medium is optical cross connect equipment which is formed between said excitation light light sources and said optical switch sections, and is characterized by having the means which carries out the reception recovery of this excitation light at said two or more outgoing ends.
[Claim 3] Said excitation light light source is optical cross connect equipment containing the supervisory-signal generator (16) which generates the light source (26) and said identifiable signal, and carries out direct modulation of this light source according to claim 1 or 2.
[Claim 4] Said excitation light light source is optical cross connect equipment containing the light source (27) which generates continuation light, and the supervisory-signal generator (16) which generates said identifiable signal and the optical modulator (28) which modulates the output light of said light source by said identifiable signal according to claim 1 or 2.
[Claim 5] Said optical switch section is optical cross connect equipment according to claim 1 to 4 with which concatenation was equipped with more than one, and said optical amplification medium was inserted between this optical switch section.

[Claim 6] The optical cross connect network by which optical cross connect equipment according to claim 1 to 5 was connected to two or more concatenation.
[Claim 7] Said optical amplification medium is optical cross connect equipment according to claim 1 to 5 which is an erbium-doped optical fiber.
[Claim 8] Said optical amplification medium is optical cross connect equipment according to claim 1 to 5 which is a PURASEODIUMU addition optical fiber.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention is used for optical communication. This invention is suitable for using for the optical exchange. This invention is used for the monitor of the lightwave signal transit route in optical cross connect equipment. Especially, it is related with the reduction technique of the lightwave signal loss ratio accompanying insertion of a monitor means.
[0002]
[Description of the Prior Art] Between [which used the fiber optic cable / two or more] optical transmission lines are switched by the optical switch section, and the optical cross connect equipment for connecting with the phase hand of a request of a lightwave signal is known. Conventionally, this optical cross connect equipment was equipped with the light amplifier, in order to compensate the insertion loss of the optical switch section, and it is equipped with the monitoring arrangement section for supervising the connection situation of the optical switch section. This conventional example is explained with reference to drawing 5 . Drawing 5 is the whole cross connect equipment block . diagram of the conventional example.
[0003] In drawing 5 , for the input edge of a lightwave signal, and OUT, the outgoing end of a lightwave signal and 80 are [IN / the optical switch section and 13b of a light amplifier and 12] optical separators, and an optical multiplexing machine and 13a are constituted by the optical WDM (Wavelength Division Multiplex: wavelength division multiplexing) coupler, respectively. As for the light source for a monitor in which 14 has a light modulation function, and 15, the receiver of monitor light and 16 are supervisory-signal generators.
[0004] Multiplex [of the lightwave signal inputted from the input edge IN] is carried out to the light for a monitor outputted from the light source 14 by optical multiplexing machine 13b, and it is inputted into the optical switch section 12. The light which passed two or more optical switch sections 12, and was inputted into optical separator 13a is divided into a lightwave signal and monitor light by optical separator 13a. Monitor light is received by the receiver 15, and after a lightwave signal is inputted into a light amplifier 80 and has the optical reinforcement amplified, it is outputted from an outgoing end OUT. moreover , since it can specify which receiver 15 receive the light which came from the light source 14 of which channel by apply the modulation to the extent which hardly influence the lightwave signal inputted from the input edge IN by the frequency or modulation pattern which use the supervisory signal generator 16 at the light source 14 of each channel , and be different , the connection situation of the optical switch section 12 can be supervise .
[0005] The configuration of a light amplifier 80 was shown in drawing 6 . Drawing 6 is the block block diagram of the light amplifier 80 of the conventional example. The light amplifier 80 is constituted by the excitation light light source 60, optical multiplexing machine 22b, and the optical

amplification medium 24. It is multiplexed with the excitation light from the excitation light light source 60 which is inputted into optical multiplexing machine 22b from a port 31, and is inputted from a port 32, and the lightwave signal separated spectrally by optical separator 13a is outputted from a port 30, is amplified by the optical amplification medium 24, and is outputted from an outgoing end OUT.
[0006] As an optical amplification medium used for the optical amplification by excitation light, when a lightwave signal is 1.5-micrometer band, an erbium-doped optical fiber is suitable, and when a lightwave signal is 1.3-micrometer band, the PURASEODIUMU addition optical fiber is suitable.
[0007]
[Problem(s) to be Solved by the Invention] In such a conventional configuration, it is necessary to prepare only optical multiplexing machine 13b for inputting into the optical switch section 12 the light source 14 which generates the light for supervising the connection situation of the optical switch section 12, and its light, and optical separator 13a it is made not to make monitor light reveal monitor light to the output of ejection and cross connect equipment from the output of the optical switch section 12 in supervisory signals. Thus, if the optical device of an optical multiplexer/demultiplexer and others is added, while the optical loss of itself will be added, branching, an insertion loss, etc. are derived.
[0008] This invention is carried out to such a background and aims at offering the optical cross connect equipment which does not need the light source or the optical multiplexer/demultiplexer only for monitor light. This invention aims at offering the optical cross connect equipment which can reduce the number of optical devices to be used. This invention aims at offering the optical cross connect equipment which can reduce optical loss, or branching and an insertion loss. This invention aims at offering the cross connect equipment which can attain economization and high performance-ization.
[0009]
[Means for Solving the Problem] This invention is optical cross connect equipment which is equipped with two or more input edges into which a lightwave signal is inputted, the optical switch section which makes change selection of the method way of an output of the lightwave signal inputted from this input edge, and is outputted to either of two or more outgoing ends, and a light amplifier, and contains the excitation light light source and an optical amplification medium in this light amplifier.
[0010] The place by which it is characterized [of this invention] here said light amplifier It has for said two or more outgoing ends of every, respectively. Said excitation light light source Become irregular with a respectively identifiable signal for two or more of these outgoing ends of every, and it has a means to make said method way of an output go back in said direction of an input edge, and to make this excitation light transmit to it. Said optical amplification medium is formed between said excitation light light sources and said optical switch sections, and is in the place which equipped said two or more input edges with the means which carries out the reception recovery of this excitation light.
[0011] It has said light amplifier for said two or more input edges of every, respectively. Or said excitation light light source Become irregular with a respectively identifiable signal for two or more of these input edges of every, and it has a means to make said method way of an output transmit this excitation light in said direction of an outgoing end. Said optical amplification medium is formed between said excitation light light sources and said optical switch sections, and is good for said two or more outgoing ends also as a configuration equipped with the means which carries out the reception recovery of this excitation light.
[0012] Thus, by modulating the excitation light light source of the light amplifier by optical pumping, the light source for a monitor is made unnecessary and the above-mentioned technical problem is solved. Since the light amplifier originally has a means to input excitation light into the path of a

lightwave signal, a means to input into the path of a lightwave signal can also make the light source for a monitor serve a double purpose, and it can also do a means to input the light for a monitor as it is unnecessary. The travelling direction of the excitation light in the path of a lightwave signal can expect a lightwave signal and the effectiveness same also in this direction or hard flow.
[0013] Said light source can be considered as the configuration which carries out direct modulation of the light source with said identifiable signal. Moreover, it can consider as the configuration which establishes a modulation circuit in the output circuit of the light source with said identifiable signal.
[0014] Concatenation is equipped with two or more said optical switch sections, and they can also be considered as the configuration in which said optical amplification medium was inserted between this optical switch section. In this case, the optical loss compensation between the optical switch sections also becomes possible.
[0015] It can also constitute as an optical cross connect network by which said optical cross connect equipment was connected to two or more concatenation.
[0016] As for said optical amplification medium, it is desirable that they are an erbium-doped optical fiber or a PURASEODIUMU addition optical fiber.
[0017] When the optical amplification medium used for the light amplifier by optical pumping considers especially loss and profitability, although it can consider various things, when a lightwave signal is 1.3-micrometer band, a PURASEODIUMU addition optical fiber is good [a medium / when a lightwave signal is 1.5 micrometer band, its erbium-doped optical fiber is good, and]. Moreover, it is also possible to modulate the bias of the excitation light source etc. and to modulate it by the external modulator by making excitation light into fixed light about the modulation of excitation light. In order to transmit and receive the signal for a monitor within the equipment, it becomes possible [using in common] by making into the light source the light source for excitation of a light amplifier which suited conventional optical cross connect equipment, and inserting the excitation light of a light amplifier in the optical switch section using the optical multiplexing machine which multiplexs a lightwave signal.
[0018] Thus, the optical cross connect equipment which needs neither the light source only for monitors for supervising the connection situation of the optical switch section which was the need conventionally by this invention, nor the optical multiplexer/demultiplexer only for monitors can be easily constituted now.
[0019]
[Embodiment of the Invention] The gestalt of operation of this invention is explained with reference to drawing 1 thru/or drawing 4 . Drawing 1 is the whole first example block diagram of this invention. Drawing 2 is the whole second example block diagram of this invention. Drawing 3 is the whole third example block diagram of this invention. Drawing 4 is the whole fourth example block diagram of this invention.
[0020] This invention is optical cross connect equipment which is equipped with two or more input edges IN into which a lightwave signal is inputted, the optical switch section 12 which makes change selection of the method way of an output of the lightwave signal inputted from this input edge IN, and is outputted to either of two or more outgoing ends OUT, and a light amplifier 80, and contains the excitation light light source 25 and the optical amplification medium 24 in this light amplifier 80, as shown in drawing 1 .
[0021] The place by which it is characterized [of this invention] here a light amplifier 80 It has for two or more outgoing ends OUT of every, respectively. The excitation light light source 25 It becomes irregular with a respectively identifiable signal for two or more of these outgoing ends OUT of every. It has optical multiplexing machine 22b as a means which makes said method way of an output go back in the input edge IN direction, and makes this excitation light transmit to it. The

optical amplification medium 24 is formed between the excitation light light source 25 and the optical switch section 12, and is in the place which equipped two or more input edges IN with the receiver 23 as a means which carries out the reception recovery of this excitation light.

[0022] As shown in drawing 2 , or a light amplifier 80 It has for two or more input edges IN of every, respectively. The excitation light light source 25 It becomes irregular with a respectively identifiable signal for two or more of these input edges IN of every. It has optical multiplexing machine 22b as a means which makes said method way of an output transmit this excitation light in the outgoing end OUT direction. The optical amplification medium 24 is formed between the excitation light light source 25 and the optical switch section 12, and can also be considered as the configuration which equipped two or more outgoing ends OUT with the receiver 23 as a means which carries out the reception recovery of this excitation light.

[0023] Moreover, as shown in drawing 3 , concatenation is equipped with two or more optical switch sections 12, and they can also be considered as the configuration in which the optical amplification medium 24 was inserted between this optical switch section 12.

[0024] Furthermore, as shown in drawing 4 , the optical cross connect network by which optical cross connect equipment was connected to two or more concatenation can also be constituted.

[0025] The optical amplification medium 24 is an erbium-doped optical fiber or a PURASEODIUMU addition optical fiber.

[0026]

[Example]

(The first example) The first example of this invention is explained with reference to drawing 1 . Drawing 1 is the whole first example block diagram of this invention. An optical isolator and 22a of 21a and 21b of drawing 1 (a) are an optical separator and a receiver for a monitor in 23. 24 is the optical amplification medium which has the magnification function of the optical reinforcement of the lightwave signal inputted from the input edge IN, as for the case of the lightwave signal of an erbium (Er) addition optical fiber, and a wavelength the band of 1.3 micrometers, in the case of the lightwave signal of a wavelength the band of 1.5 micrometers, a (PURASEODIUMU Pr) addition optical fiber is usually used, but although effectiveness is bad, it can also use a YAG crystal and a HeNe gas. 25 is the light source which outputs the light for exciting the optical amplification medium 24 on which the signal for a monitor is put. The wavelength of the light generally outputted from the light source 25 differs from the wavelength of a lightwave signal.

[0027] The example of a configuration of the light source 25 is shown in drawing 1 (b) and (c). It is the light source in which 16 has a supervisory-signal generator and 26 has a light modulation function, and solid state laser which has a modulation function in the semiconductor laser by which direct modulation was carried out, or excitation light can realize. 27 is the light source for exciting the optical amplification medium 24, and semiconductor laser, solid state laser, etc. can realize it. 28 is an optical modulator and an optical modulator, a semi-conductor optical modulator, etc. using LN crystal can realize it. 10, 11, and 12 are input/output port of optical separator 22a. 30, 31, and 32 are input/output port of optical multiplexing machine 22b. The monitoring arrangement section which 41 becomes from optical-isolator 21a, optical separator 22a, and a receiver 23, and 42 point out the monitoring arrangement section which consists of optical-isolator 21b, optical multiplexing machine 22b, an optical amplification medium 24, and the light source 25. Optical separator 22a has the function which outputs the lightwave signal inputted from the port 10 to a port 11, and outputs the monitor light inputted from the port 11 to a port 12. Moreover, optical multiplexing machine 22b has the function which outputs the lightwave signal inputted from the port 30 to a port 31, and outputs the monitor light inputted from the port 32 to a port 30. Optical separator 22a and optical multiplexing machine 22b are realizable with an optical directional coupler, an optical WDM coupler, an optical

circulator, etc. In a certain case, the cross talk of optical separator 22a and optical multiplexing machine 22b can omit optical isolators 21a and 21b enough.

[0028] The lightwave signal inputted from the input edge IN passes along optical-isolator 21a of the monitoring arrangement section 41, and optical separator 22a, and is inputted into the optical switch section 12. The lightwave signal which passed two or more optical switch sections 12 goes into the optical amplification medium 24 of the monitoring arrangement section 42, and the optical reinforcement is amplified by the optical amplification medium 24. The lightwave signal with which optical reinforcement was amplified is outputted to an outgoing end OUT through optical multiplexing machine 22b and optical-isolator 21b by the optical amplification medium 24.

[0029] The light (excitation light) for on the other hand exciting the optical amplification medium 24 which came out of the light source 25 is inputted into optical multiplexing machine 22b from a port 32, and is inputted into the optical amplification medium 24 from a port 30. Excitation light is inputted from the right end of the optical switch section 12 through the optical amplification medium 24. The excitation light which passed two or more optical switch sections 12 arrives at the port 11 of optical separator 22a of the monitoring arrangement section 41, is taken out by the port 12 and received by optical separator 22a with a receiver 23.

[0030] since it can specify which receiver 23 have receive the light which came from the light source 25 of which channel by apply the modulation to the extent which hardly influence the lightwave signal inputted from the input edge IN like the conventional example by the frequency or modulation pattern which be different in the output light of the light source 25 of each channel , the connection situation of the optical switch section 12 can be supervise .

[0031] (The second example) Next, the second example of this invention is explained with reference to drawing 2 . Drawing 2 is the whole second example block diagram of this invention. In the second example of this invention, the light source 25 which outputs the light for exciting the optical amplification medium 24 by which the signal for the optical amplification medium 24 and a monitor is put on the input side of the optical switch section 12 is arranged. 22b is an optical multiplexing machine and 22a is an optical separator. 30, 31, and 32 are input/output port of optical multiplexing machine 22b. 10, 11, and 12 are input/output port of optical separator 22a. 33 attenuates the excitation light which is an optical filter and is outputted from the light source 25. The monitoring arrangement part which 41 becomes from optical multiplexing machine 22b, the optical amplification medium 24, and the light source 25, and 42 point out the monitoring arrangement part which consists of a receiver 23, optical separator 22a, and an optical filter 33.

[0032] Optical multiplexing machine 22b outputs the lightwave signal inputted from the port 31 to a port 30, and outputs the monitor lightwave signal inputted from the port 32 to a port 30. Moreover, optical separator 22a outputs the lightwave signal inputted from the port 11 to a port 10, and outputs the monitor light inputted from the port 11 to a port 12. Optical multiplexing machine 22b and optical separator 22a are realizable with an optical WDM coupler and an optical coupler. An optical filter 33 has the work which attenuates the excitation light outputted from the light source 25. An optical filter 33 can be omitted when an optical WDM coupler is used for optical multiplexing machine 22b and optical separator 22a. Moreover, originally, since excitation light uses the wavelength well absorbed by the optical amplification medium 24, also when excitation light is declining to extent which does not affect a lightwave signal, it can omit.

[0033] The lightwave signal inputted from the input edge IN passes along optical multiplexing machine 22b, and is inputted into the optical amplification medium 24, and the optical reinforcement is amplified by the optical amplification medium 24. The output of the optical amplification medium 24 passes along two or more optical switch sections 12, and is outputted to an outgoing end OUT through optical separator 22a and an optical filter 33.

[0034] The light (excitation light) for on the other hand exciting the optical amplification medium 24 which came out of the light source 25 is inputted into the optical amplification medium 24 from a port 30 through a port 32 and optical multiplexing machine 22b. Excitation light is inputted from the left-hand side of the optical switch section 12 through the optical amplification medium 24. The excitation light which passed two or more optical switch sections 12 reaches the monitoring arrangement section 42, is taken out by the port 12 and received by optical separator 22a with a receiver 23.

[0035] since it can specify which receiver 23 have receive the light which came from the light source 25 of which channel by apply amplitude modulation to the extent which hardly influence the lightwave signal inputted from the input edge IN like the conventional example by the frequency or modulation pattern which be different in the output light of the light source 25 of each channel , the connection situation of the optical switch section 12 can be supervise .

[0036] (The third example) Next, the third example of this invention is explained with reference to drawing 3 . Drawing 3 is the whole third example block diagram of this invention. In the third example of this invention, the optical amplification medium 24 is suitably inserted between the optical switch sections 12. The monitoring arrangement sections 41 and 42 are the same as that of what was explained in this invention first or the second example. The secondary effectiveness of in such a configuration raising the degree of freedom of a design of the level diagram in equipment since it can design so that the optical reinforcement of a lightwave signal can be amplified between the optical switch sections 12 of arbitration is acquired.

[0037] (The fourth example) Next, the fourth example of this invention is explained with reference to drawing 4 . Drawing 4 is the whole fourth example block diagram of this invention. In the fourth example of this invention, multistage (n steps) connection of the configuration shown in this invention first or the second example is made, and the case where an optical cross connect network with more large magnitude is constituted is shown. The optical switch section 12 and the monitoring arrangement sections 41 and 42 are the same as that of what was explained in this invention first or the second example.

[0038] In order to supervise the connection situation of the optical switch section 12 Can supervise for every [the monitoring arrangement section 41 of each stage #1-#n, and] 42, can also constitute so that the high order equipment which manages them in generalization may be formed, and A modulation is given to the light source 25 of excitation light using the configuration of the second example of this invention shown in the monitoring arrangement section 41 of #1 at drawing 2 . or the first rank -- In the monitoring arrangement section 42 of last stage #n, it may restore to excitation light with a receiver 23 using the configuration of the second example of this invention too shown in drawing 2 , and the connection situation of the optical switch section 12 may be supervised in it. In this case, other optical cross connect equipments of stage #2 - # (n-1) merely amplify a supervisory signal, and should just send it out to the latter part.

[0039] moreover, the configuration of the first example of this invention shown in the monitoring arrangement section 42 of last stage #n in this case at drawing 1 although the configuration of the first example of this invention could be used -- using -- the light source 25 of excitation light -- a modulation -- giving -- the first rank -- it may restore to excitation light with a receiver 23 in the monitoring arrangement section 41 of #1 using the configuration of the first example of this invention too shown in drawing 1 , and the connection situation of the optical switch section 12 may be supervised in it. In this case, other optical cross connect equipments of stage #2 - # (n-1) merely amplify a supervisory signal, and should just send it out to the preceding paragraph.

[0040] In addition, as the third example of this invention explained, the optical amplification medium 24 may be inserted among two or more optical switch sections 12.

[0041]
[Effect of the Invention] As explained above, according to this invention, the optical cross connect equipment which does not need the light source or the optical multiplexer/demultiplexer only for monitor light is realizable. Therefore, the number of optical devices to be used can be reduced. Thereby, optical loss, or branching and an insertion loss can be reduced. Furthermore, economization and high performance-ization can be attained.

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TECHNICAL FIELD

[Field of the Invention] This invention is used for optical communication. This invention is suitable for using for the optical exchange. This invention is used for the monitor of the lightwave signal transit route in optical cross connect equipment. Especially, it is related with the reduction technique of the lightwave signal loss ratio accompanying insertion of a monitor means.

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PRIOR ART

[Description of the Prior Art] Between [which used the fiber optic cable / two or more] optical transmission lines are switched by the optical switch section, and the optical cross connect equipment for connecting with the phase hand of a request of a lightwave signal is known. Conventionally, this optical cross connect equipment was equipped with the light amplifier, in order to compensate the insertion loss of the optical switch section, and it is equipped with the monitoring arrangement section for supervising the connection situation of the optical switch section. This conventional example is explained with reference to drawing 5 . Drawing 5 is the whole cross connect equipment block diagram of the conventional example.

[0003] In drawing 5 , for the input edge of a lightwave signal, and OUT, the outgoing end of a lightwave signal and 80 are [IN / the optical switch section and 13b of a light amplifier and 12] optical separators, and an optical multiplexing machine and 13a are constituted by the optical WDM (Wavelength Division Multiplex: wavelength division multiplexing) coupler, respectively. As for the light source for a monitor in which 14 has a light modulation function, and 15, the receiver of monitor light and 16 are supervisory-signal generators.

[0004] Multiplex [of the lightwave signal inputted from the input edge IN] is carried out to the light for a monitor outputted from the light source 14 by optical multiplexing machine 13b, and it is inputted into the optical switch section 12. The light which passed two or more optical switch sections 12, and was inputted into optical separator 13a is divided into a lightwave signal and monitor light by optical separator 13a. Monitor light is received by the receiver 15, and after a lightwave signal is inputted into a light amplifier 80 and has the optical reinforcement amplified, it is outputted from an outgoing end OUT. moreover , since it can specify which receiver 15 receive the light which came from the light source 14 of which channel by apply the modulation to the extent which hardly influence the lightwave signal inputted from the input edge IN by the frequency or modulation pattern which use the supervisory signal generator 16 at the light source 14 of each channel , and be different , the connection situation of the optical switch section 12 can be supervise .

[0005] The configuration of a light amplifier 80 was shown in drawing 6 . Drawing 6 is the block block diagram of the light amplifier 80 of the conventional example. The light amplifier 80 is constituted by the excitation light light source 60, optical multiplexing machine 22b, and the optical amplification medium 24. It is multiplexed with the excitation light from the excitation light light source 60 which is inputted into optical multiplexing machine 22b from a port 31, and is inputted from a port 32, and the lightwave signal separated spectrally by optical separator 13a is outputted from a port 30, is amplified by the optical amplification medium 24, and is outputted from an outgoing end OUT.

[0006] As an optical amplification medium used for the optical amplification by excitation light, when a lightwave signal is 1.5-micrometer band, an erbium-doped optical fiber is suitable, and when a

lightwave signal is 1.3-micrometer band, the PURASEODIUMU addition optical fiber is suitable.

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EFFECT OF THE INVENTION

[Effect of the Invention] As explained above, according to this invention, the optical cross connect equipment which does not need the light source or the optical multiplexer/demultiplexer only for monitor light is realizable. Therefore, the number of optical devices to be used can be reduced. Thereby, optical loss, or branching and an insertion loss can be reduced. Furthermore, economization and high performance-ization can be attained.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] In such a conventional configuration, it is necessary to prepare only optical multiplexing machine 13b for inputting into the optical switch section 12 the light source 14 which generates the light for supervising the connection situation of the optical switch section 12, and its light, and optical separator 13a it is made not to make monitor light reveal monitor light to the output of ejection and cross connect equipment from the output of the optical switch section 12 in supervisory signals. Thus, if the optical device of an optical multiplexer/demultiplexer and others is added, while the optical loss of itself will be added, branching, an insertion loss, etc. are derived.
[0008] This invention is carried out to such a background and aims at offering the optical cross connect equipment which does not need the light source or the optical multiplexer/demultiplexer only for monitor light. This invention aims at offering the optical cross connect equipment which can reduce the number of optical devices to be used. This invention aims at offering the optical cross connect equipment which can reduce optical loss, or branching and an insertion loss. This invention aims at offering the cross connect equipment which can attain economization and high performance-ization.

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MEANS

[Means for Solving the Problem] This invention is optical cross connect equipment which is equipped with two or more input edges into which a lightwave signal is inputted, the optical switch section which makes change selection of the method way of an output of the lightwave signal inputted from this input edge, and is outputted to either of two or more outgoing ends, and a light amplifier, and contains the excitation light light source and an optical amplification medium in this light amplifier.
[0010] The place by which it is characterized [of this invention] here said light amplifier It has for said two or more outgoing ends of every, respectively. Said excitation light light source Become irregular with a respectively identifiable signal for two or more of these outgoing ends of every, and it has a means to make said method way of an output go back in said direction of an input edge, and to make this excitation light transmit to it. Said optical amplification medium is formed between said excitation light light sources and said optical switch sections, and is in the place which equipped said two or more input edges with the means which carries out the reception recovery of this excitation light.
[0011] It has said light amplifier for said two or more input edges of every, respectively. Or said excitation light light source Become irregular with a respectively identifiable signal for two or more of these input edges of every, and it has a means to make said method way of an output transmit this excitation light in said direction of an outgoing end. Said optical amplification medium is formed between said excitation light light sources and said optical switch sections, and is good for said two or more outgoing ends also as a configuration equipped with the means which carries out the reception recovery of this excitation light.
[0012] Thus, by modulating the excitation light light source of the light amplifier by optical pumping, the light source for a monitor is made unnecessary and the above-mentioned technical problem is solved. Since the light amplifier originally has a means to input excitation light into the path of a lightwave signal, a means to input into the path of a lightwave signal can also make the light source for a monitor serve a double purpose, and it can also do a means to input the light for a monitor as it is unnecessary. The travelling direction of the excitation light in the path of a lightwave signal can expect a lightwave signal and the effectiveness same also in this direction or hard flow.
[0013] Said light source can be considered as the configuration which carries out direct modulation of the light source with said identifiable signal. Moreover, it can consider as the configuration which establishes a modulation circuit in the output circuit of the light source with said identifiable signal.
[0014] Concatenation is equipped with two or more said optical switch sections, and they can also be considered as the configuration in which said optical amplification medium was inserted between this optical switch section. In this case, the optical loss compensation between the optical switch sections also becomes possible.
[0015] It can also constitute as an optical cross connect network by which said optical cross connect equipment was connected to two or more concatenation.

[0016] As for said optical amplification medium, it is desirable that they are an erbium-doped optical fiber or a PURASEODIUMU addition optical fiber.
[0017] When the optical amplification medium used for the light amplifier by optical pumping considers especially loss and profitability, although it can consider various things, when a lightwave signal is 1.3-micrometer band, a PURASEODIUMU addition optical fiber is good [a medium / when a lightwave signal is 1.5 micrometer band, its erbium-doped optical fiber is good, and]. Moreover, it is also possible to modulate the bias of the excitation light source etc. and to modulate it by the external modulator by making excitation light into fixed light about the modulation of excitation light. In order to transmit and receive the signal for a monitor within the equipment, it becomes possible [using in common] by making into the light source the light source for excitation of a light amplifier which suited conventional optical cross connect equipment, and inserting the excitation light of a light amplifier in the optical switch section using the optical multiplexing machine which multiplexs a lightwave signal.
[0018] Thus, the optical cross connect equipment which needs neither the light source only for monitors for supervising the connection situation of the optical switch section which was the need conventionally by this invention, nor the optical multiplexer/demultiplexer only for monitors can be easily constituted now.
[0019]
[Embodiment of the Invention] The gestalt of operation of this invention is explained with reference to drawing 1 thru/or drawing 4 . Drawing 1 is the whole first example block diagram of this invention. Drawing 2 is the whole second example block diagram of this invention. Drawing 3 is the whole third example block diagram of this invention. Drawing 4 is the whole fourth example block diagram of this invention.
[0020] This invention is optical cross connect equipment which is equipped with two or more input edges IN into which a lightwave signal is inputted, the optical switch section 12 which makes change selection of the method way of an output of the lightwave signal inputted from this input edge IN, and is outputted to either of two or more outgoing ends OUT, and a light amplifier 80, and contains the excitation light light source 25 and the optical amplification medium 24 in this light amplifier 80, as shown in drawing 1 .
[0021] The place by which it is characterized [of this invention] here a light amplifier 80 It has for two or more outgoing ends OUT of every, respectively. The excitation light light source 25 It becomes irregular with a respectively identifiable signal for two or more of these outgoing ends OUT of every. It has optical multiplexing machine 22b as a means which makes said method way of an output go back in the input edge IN direction, and makes this excitation light transmit to it. The optical amplification medium 24 is formed between the excitation light light source 25 and the optical switch section 12, and is in the place which equipped two or more input edges IN with the receiver 23 as a means which carries out the reception recovery of this excitation light.
[0022] As shown in drawing 2 , or a light amplifier 80 It has for two or more input edges IN of every, respectively. The excitation light light source 25 It becomes irregular with a respectively identifiable signal for two or more of these input edges IN of every. It has optical multiplexing machine 22b as a means which makes said method way of an output transmit this excitation light in the outgoing end OUT direction. The optical amplification medium 24 is formed between the excitation light light source 25 and the optical switch section 12, and can also be considered as the configuration which equipped two or more outgoing ends OUT with the receiver 23 as a means which carries out the reception recovery of this excitation light.
[0023] Moreover, as shown in drawing 3 , concatenation is equipped with two or more optical switch sections 12, and they can also be considered as the configuration in which the optical amplification

medium 24 was inserted between this optical switch section 12.

[0024] Furthermore, as shown in drawing 4 , the optical cross connect network by which optical cross connect equipment was connected to two or more concatenation can also be constituted.

[0025] The optical amplification medium 24 is an erbium-doped optical fiber or a PURASEODIUMU addition optical fiber.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The whole first example block diagram of this invention.
[Drawing 2] The whole second example block diagram of this invention.
[Drawing 3] The whole third example block diagram of this invention.
[Drawing 4] The whole fourth example block diagram of this invention.
[Drawing 5] The whole cross connect equipment block diagram of the conventional example.
[Drawing 6] The block block diagram of the light amplifier of the conventional example.
[Description of Notations]
10-12, 30-32 Port
12 Optical Switch Section
13a, 22a Optical separator
13b, 22b Optical multiplexing machine
14, 25, 26, 27, 60 Light source
15 23 Receiver
16 Supervisory-Signal Generator
21a, 21b Optical isolator
24 Optical Amplification Medium
28 Optical Modulator
33 Light Filter
41 42 Monitoring arrangement section
80 Light Amplifier
IN Input edge
OUT Outgoing end

[Translation done.]

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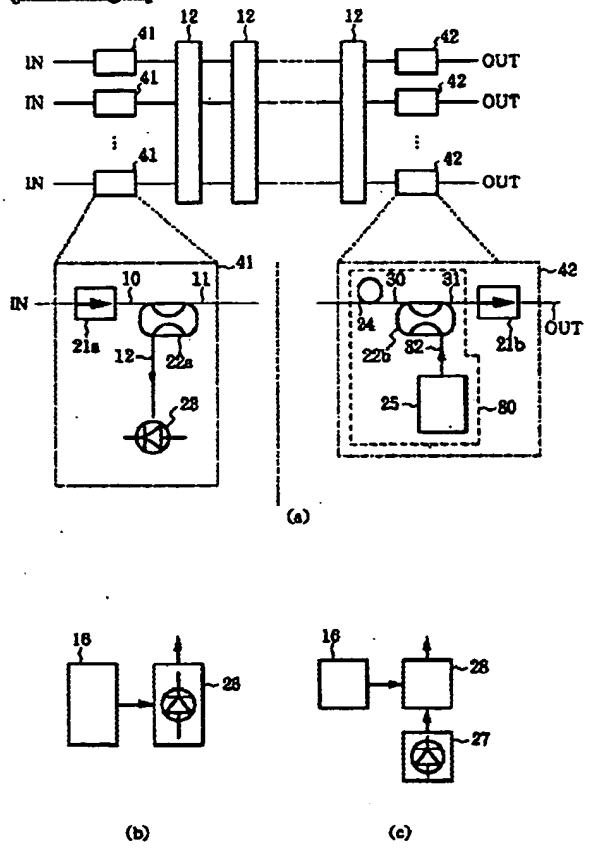
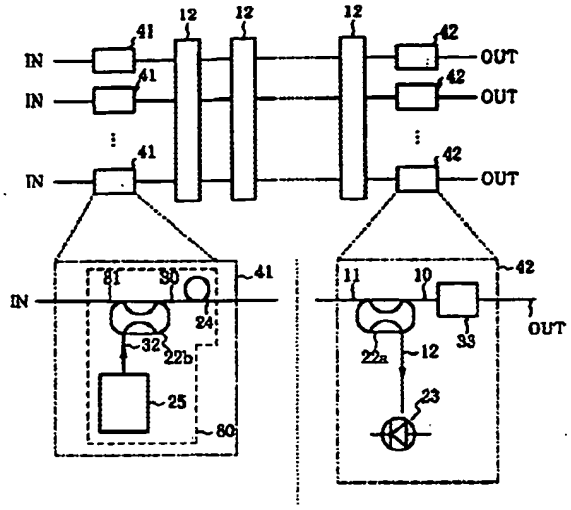
DRAWINGS

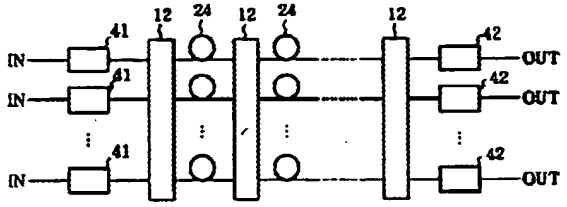
[Drawing 1]



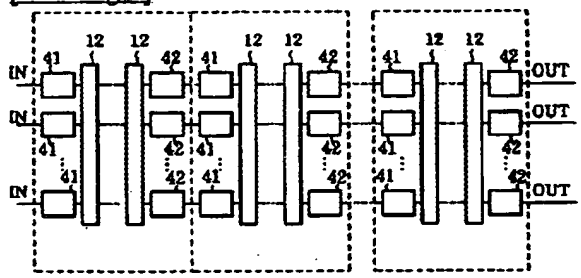
[Drawing 2]



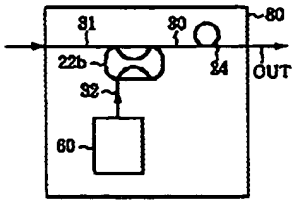
[Drawing 3]



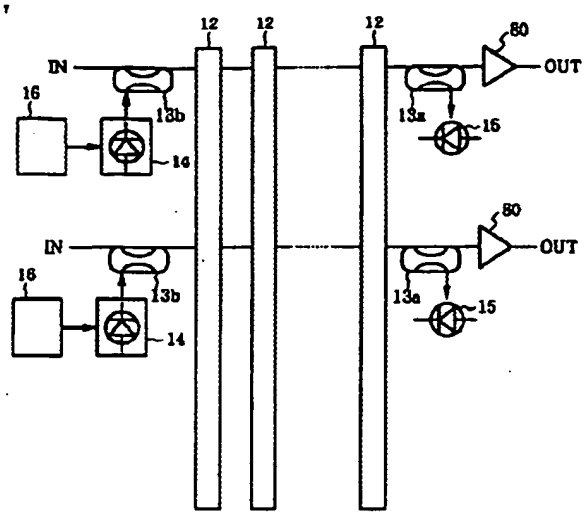
[Drawing 4]



[Drawing 6]



[Drawing 5]



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